DEPARTMENT OF AGRICULTURE AND STOCK.

The CANE GROWERS' QUARTERLY BULLETIN

ISSUED BY
BUREAU OF SUGAR EXPERIMENT STATIONS
BRISBANE, QUEENSLAND.

VOL. IV. No. 2. 1 OCTOBER, 1936.

Contents.

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BRISBANE

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ISSUED BY DIRECTION OF THE
HON. F. W. BULCOCK, MINISTER
FOR AGRICULTURE AND STOCK

1 OCTOBER, 1936

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The

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P. O. J. 2878 and P. O. J. 2725 Under Irrigation at the Bundaberg Experiment Station.

AN irrigated fertilizer experiment recently harvested at the Bundaberg Experiment Station exhibited results of extreme interest to local growers. The block was planted in March, 1935, after a poor crop of Poona pea had been ploughed under; the planting conditions were so dry that it was considered advisable to irrigate for a strike.

The block is some five chains long on a slight slope, and was planted with P.O.J. 2725 and P.O.J. 2878—each variety running from top to bottom of the block. The early waterings were carried out in the planting furrow, and later a water furrow was run on either side of each row of cane. The lower end of the block, about two-fifths of the total length, was frosted badly during the last week in June. The stools shot away again, and just a month later were frosted badly again. The second time they came away, a few gaps were apparent where certain stools had been killed completely. During this period the top three-fifths of the block was not affected by frost.

The block was irrigated frequently until March, 1936. By this time a good stand of cane was visible and a three-days gale blew the more advanced P.O.J. 2725 flat. The adjoining P.O.J. 2878 of almost similar height remained upright—as did also the cane on those plots which had been frosted during the previous winter. After the period of the gale it was impossible to irrigate, the fallen cane having blocked the water furrows.

The number of irrigations from frosting period was nine, and the average application was calculated at from four to five inches. The number of irrigations is excessive for the period stated, but it will be recollected that the district experienced an extremely dry spring and summer, and suffered from the absence of the usual wet season rains.

When the experiment was started, it was decided to carry out fortnightly irrigations when suitable falls of rain did not intervene. The following table shows the dates of irrigations, and of falls of rain approximating or exceeding one inch.

March 25	irrigated for strike
April 5-6	5·15 inches
April 19	1·05 inches
May 14	irrigation
May 26	1·78 inches
July 8-9	4·98 inches
August 15	irrigation
September 9-12	1·38 inches
September 18	0·93 inches
October 9	irrigation
October 21	1·10 inches
October 30	irrigation
November 15	irrigation
November 27	irrigation
December 11	irrigation
December 14	5·84 inches
December 28-29	2·60 inches
January 9-13	4·11 inches
January 22	irrigation
February 6	irrigation
February 16	irrigation
March 2-4	1·87 inches
March 20-23	6·04 inches
May 11-15	1·39 inches
June 22-24	5·09 inches

The experiment was a quantitative nitrogen trial, all twenty-five plots receiving potash and superphosphate, and the sulphate of ammonia applications varied from nil to 480 lb. per acre in 120 lb. increments. The results of the trial are shown below. No significant results are apparent from the sulphate of ammonia applications, the yields being no doubt influenced by (1) frosting of some plots, (2) the difficulty of even application of water, and (3) the blowing down of only certain plots in the trial.

YIELDS.

P.O.J. 2878	50·5 tons per acre.
P.O.J. 2725	63·0 tons per acre.

Taking certain areas separately we find that—

The non-frosted P.O.J. 2725 averaged 68·4 tons per acre, the heaviest plot being 86·6, and the lightest 57·0 tons per acre;

The non-frosted P.O.J. 2878 averaged 55·0 tons per acre, the heaviest plot being 60·9, and the lightest 48·6;

The frosted P.O.J. 2725 averaged 54·8 tons per acre, the heaviest plot being 57·0, and the lightest 53·0;

The frosted P.O.J. 2878 averaged 43·85 tons per acre, the heaviest plot being 48·0, and the lightest 40·2.

Prior to the lodging of the P.O.J. 2725 this variety was visibly ahead of the 2878 in growth, although every effort had been made to apply similar waterings to the two varieties. The tonnages at harvest confirmed this without any doubt. We must therefore accept that under

these conditions 2725 is a superior cane to 2878 in crop production. The resistance of the 2878 to wind, however, is a point in this variety's favour. Standing cane, apart from other advantages, always matures earlier than a recumbent crop.

In a previous article the writer pointed out the unsuitability of P.O.J. 2725 for the Woongarra lands owing to its arrowing, and inability on that account to be grown for a standover crop. If irrigated, however, the need to standover would not arise. An irrigated block of this variety could be ear-marked for yearly harvesting, and the other varieties on the farm utilized for the standover percentage.

The ratoons of the above trial have the trash raked in alternate interspaces; the bare interspaces will carry water furrows, and the fertilizer treatments have been repeated. We look forward with interest to the performance of these varieties in the ratoon stage.

Fiji Disease.

Eradication of Diseased Stools in Young Sugar Cane.

IN those districts in Southern Queensland where Fiji disease of sugar-cane is present, farmers should now be on the watch for the disease in their young plant and ratoon cane. Fiji disease is spread from diseased to healthy cane by the sugar-cane leaf hopper, a small brownish insect about one-fifth of an inch long. This insect is relatively scarce now and will remain so until about December, when it will commence to multiply rapidly. It is therefore important that the destruction of diseased stools of cane should be carried out while the insect is still scarce; if the job is postponed until December and January then it is almost certain that the hoppers will have carried the disease to some of the stools surrounding each diseased stool.

Young diseased stools will usually appear stunted, stiff, and somewhat scraggy, and on the under surface of the leaves will be found small yellowish galls, about $\frac{1}{32}$-$\frac{1}{16}$ inch in diameter, and ranging from $\frac{1}{8}$ to 2 inches in length. As a rule these galls are not particularly numerous, and sometimes there may be only one or two on a leaf. If any doubt exists as to whether Fiji disease is present or not, it is best to be on the safe side and dig out the suspected stool.

On irrigated lands and the richer river flats, Fiji disease is more difficult to control, but otherwise it can be readily controlled provided all diseased stools are carefully dug out *early in the season* as outlined above. Of the varieties commonly grown in the southern part of the State, P.O.J. 2878, P.O.J. 2714, 1900 Seedling, and D. 1135 are susceptible, while Q. 813, H.Q. 285, P.O.J. 213, P.O.J. 234, and Co. 290 are resistant, the last three being particularly so.

A.F.B.

Some Cane Varietal Trials Harvested during 1936.

By H. W. Kerr.

A NUMBER of new cane varieties have received attention in the southern sugar areas during recent years, and it is pleasing to report that some of the new gum-resistant canes have far out-yielded the older disease-susceptible varieties. Taking the census of recent plantings as a guide, it appears safe to conclude that in the course of a few years, the canelands in these parts will be entirely planted to new varieties, and the old canes will be discarded for all time.

It is unfortunate that our trials with the canes which do so well in the south have not met with the same measure of success in the northern canelands. P.O.J. 2878, for example, is most disappointing in the humid north. Doubtless there exists the need for new canes in those parts, and every effort is being made to breed suitable new canes at the Meringa Station, which will fill this need. A small number of such new canes (which receive the prefix "Q"), were placed in trials for the first time last year. The results of the experiments are reported herewith, and at least one of these (Q. 2) appears to possess definite promise on the second class lands of the north. Variety P.O.J. 2725 was further tried out against Clark's seedling and the Q. seedlings in the Cairns district, but it shows certain disappointing features which would appear to condemn it.

In the Mackay district, a varietal trial containing the old standard canes, together with S.C.12/4 (a leading variety of the West Indies) and P.O.J. 2878, was conducted by Mr. M. Powell, of Foulden, Farleigh, and through the courtesy of this gentleman, the results of the experiment are reported herewith.

We feel sure that growers will be interested to study the results of the yield trials which are contained in the following pages; and it should be needless to add that the Bureau is keenly appreciative of the economic benefits to be derived from the planting of new and superior varieties. The pursuit of this objective, both by breeding new canes in Queensland, and by importing the promising varieties from overseas countries, is now one of the major projects of our organisation.

NORTHERN DISTRICT.

Three varietal trials have been harvested in the far northern areas during the current season. The following individual results, and comments thereon are supplied by the Instructor in Cane Culture, Mr. G. Bates:—

Mr. W. Cannon's farm, White Rock, Cairns.

Soil type—Red schist loam.
Nature of crop—Plant cane.
Age of crop—12 months.

Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
S.J. 4	**40.9**	12·6
Q. 2	34·7	**14.6**

Discussion.

Varieties Q.1 and Q.4 were also included in the experiment, but the germinations experienced were so poor, that the plots were replanted with S.J.4.

On the yields reported, S.J. 4 has given a much larger tonnage of cane per acre than Q. 2, but the superiority in C.C.S. of the latter variety is exactly 2 units. This cane was selected in a large measure due to its sweetness, and in a year characterised by low c.c.s. returns, the above figures are remarkably good.

A fair strike was obtained with Q. 2 on this area, and the cane made good growth. A feature of the new cane is its extraordinary free trashing, which gives the crop a unique appearance, and incidentally, permits the growth of winter weeds. It remains to be seen whether this characteristic will prove objectionable. Certainly its freedom from trash will prove an advantage in harvesting, and remove the necessity for pre-harvest burning, despite the rather slender stalk which the variety possesses.

Mr. J. B. Anderson's farm, Woree, Cairns.

Soil type—Schist loam.

Nature of crop—Plant cane.

Age of crop—11 months.

Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
Clark's Seedling	41.4	13.85
P.O.J. 2725	41·3	9·1

Discussion.

Both canes germinated well, but the P.O.J. variety has an unfortunate spreading habit during its early growth, necessitating more chipping than other canes. It possesses splendid stooling qualities, but it arrowed very early, and the upper eyes had "shot" when the crop was harvested.

There was little difference in the yields of cane per acre from the two varieties, but the c.c.s. results were very distinctly in favour of the Clark's Seedling. The crop was cut on the 16th July, which probably accounts for much of the discrepancy.

It would appear that P.O.J. 2725 is not suited to North Queensland conditions, due to its inferior c.c.s., its prolific and early arrowing, and pithiness of the stalk.

Messrs. Hickling Bros.' farm, Aloomba.

Soil type—Schist loam.
Nature of crop—Plant cane.
Age of crop—12 months.

Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
Clark's Seedling	40·7	**15.1**
Q. 2	37·5	**15.1**
P.O.J. 2725	**43.0**	11·5

Discussion.

This trial also included Q. 8, which gave an unsatisfactory germination, and was therefore discarded from the trial. Clark's Seedling and P.O.J. 2725 gave a good and rapid germination; that of Q. 2 was somewhat slow, though fairly satisfactory.

The Clark's Seedling and P.O.J. 2725 had lodged somewhat at harvest time; the latter was notably defective in this regard, while it arrowed very freely and early. Q. 2 was tall and quite erect, when harvested, and showed no arrowing. The results show that P.O.J. 2725 gave the heaviest cane tonnage, though its low c.c.s. is noteworthy. Clark's Seedling out-yielded Q. 2 by 3 tons per acre, while the c.c.s. values were identical.

Again the unfavourable features of P.O.J. 2725 are to the fore, while the results from Q. 2 suggest that the new variety is worthy of further trial.

CENTRAL DISTRICT.

Mr. T. A. Powell's farm, Foulden, Farleigh.

Soil type—Alluvial sandy loam.
Nature of crop—Plant cane.
Age of crop—15 months.

Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
S.C. 12/4	26·9	**16.1**
M. 1900 Seedling	29·1	15·3
E.K. 28	30·9	15·6
Q. 813	31·0	15·2
P.O.J. 2878	**38.9**	15·6

Discussion.

The canes were planted under ideal soil conditions, and a rapid germination resulted. A growth check during early summer was relieved by February rains, and the crop made good growth until harvested.

The cane yields show P.O.J. 2878 as outstandingly superior to all other varieties. It is worthy of note that this variety was quite erect at harvest time, whereas some plots of Q. 813 and E.K. 28 were lodged and tangled. S.C. 12/4 showed the highest c.c.s. value, with P.O.J. 2878 and E.K. 28 next in order. As the crop was harvested late in the season, this was to be expected.

SOUTHERN DISTRICT.

Windermere Plantation, Bundaberg.

Soil type—Red volcanic loam.

Nature of crop—First ratoons.

Age of crop—10 months.

Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
P.O.J. 2940	7·9	14·2
D. 1135	12·4	12·4
P.O.J. 36	15·1	**15.1**
Co. 290	20·1	13·6
P.O.J. 2883	**20.9**	13·8

Discussion.

The plant crop was harvested in November, 1935. All varieties except P.O.J. 2940 ratooned strongly. P.O.J. 2940 was virtually a failure on all plots. The unsatisfactory germination results obtained with this cane demand that it be not persisted with in the future.

The striking feature of the results is the superiority of P.O.J. 2883, which is of a type suggesting a good standover variety. It will form the subject of further extensive trials during 1937. Co.290 was a close second in cane yield, with almost identical C.C.S. results. The standard —D.1135—was very definitely inferior in both cane and sugar yields.

It is of interest to repeat the results of the plant crop of this trial, which were recorded in the Quarterly Bulletin for January, 1936:—

Variety.	Plant Crop.		First Ratoons.	
	Cane per Acre.	C.C.S. in Cane.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.	Tons.	Per cent.
P.O.J. 2940	23·9	**16.2**	7·9	14·2
D. 1135	19·7	12·9	12·4	12·4
P.O.J. 36	27·4	14·4	15·1	**15.1**
Co. 290	**33.1**	15·5	20·1	13·6
P.O.J. 2883	29·1	15·1	**20.9**	13·8

Mr. H. A. Ilett's farm, Apple Tree Creek, Childers.

Soil type—Red volcanic loam.

Nature of crop—Standover plant cane.

Age of crop—23 months.

Yields.

Variety.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
P.O.J. 2940	33·3	15·4
P.O.J. 2725	36·7	**15.5**
B. 417	37·0	15·0
P.O.J. 2883	41·0	15·4
P.O.J. 2878	**44.0**	14·9

Discussion.

This trial was rather of the nature of an observational experiment, for although it had five plots of P.O.J. 2878, only one plot of each of the other varieties was included.

The yields indicate the superiority of P.O.J. 2878, which has now become the standard variety of the Isis area. But P.O.J. 2883 was a close second and actually superior in C.C.S. (These results should be compared with those reported for Windermere Plantation, p. 43).

P.O.J. 2940 was again at a disadvantage in this trial, while P.O.J. 2725 and B. 417 were also distinctly inferior.

Mr. F. M. Schleger's farm, Sandhills Road, Bundaberg.

Soil type—Brown volcanic loam.

Nature of crop—Second ratoon.

Age of crop—10 months.

Yields.

Variety.	Plant Cane.		1st. Ratoon.		2nd. Ratoon.	
	Cane per Acre.	C.C.S.	Cane per Acre.	C.C.S.	Cane per Acre.	C.C.S.
	Tons.	Per Cent.	Tons.	Per Cent.	Tons.	Per Cent.
Q. 1098	40·9	12·2	43·3	13·3	20·5	**14.3**
P.O.J. 2379	37·8	13·5	40·1	**15.1**	22·1	13·1
P.O.J. 234	38·6	**14.4**	37·2	14·4	22·1	12·4
P.O.J. 2878	39·4	12·8	47·5	14·2	23·2	13·8
Co. 290	**48.7**	13·5	**49.8**	13·7	**32.5**	13·5

Discussion.

This trial has now been carried through three crops, and the full results for each harvest are included in the above table.

Co. 290 was clearly the most valuable cane under these particular conditions. In three years, it yielded 131 tons of cane from an acre—an average of almost 44 tons per annum. Its c.c.s. values were also quite satisfactory. Second in order was P.O.J. 2878, though it fell much below Co. 290 on the second ratoon yield.

Under conditions such as these, it would be difficult to predict just how frequently Co. 290 could be ratooned with profit; but a yield of over 32 tons per acre for second ratoons suggests that the process could be carried substantially beyond this point.

Stem Rot in Standover P.O.J. 2878 in the Bundaberg—Isis District.

By ARTHUR F. BELL.

DURING the 1935 season a reddish stem rot was observed in some standover P.O.J. 100 growing on a farm in the Isis Central Mill area. This season a watch was maintained for the disease, and officers of the Bureau and the Isis Central Mill have found it in a number of fields in the Bundaberg-Isis district. In each case the crop attacked has been standover P.O.J. 2878.

The disease is somewhat similar to the well-known red rot in appearance. The flesh in the affected parts of the stem takes on a bright reddish colour, which extends right through to the rind, on which appear bright red patches. As the disease progresses the colour of flesh and rind changes to brown and sometimes dark grey, while the stem becomes shrunken and dry. The buds on the affected part of the stem soon become discoloured and die, and in the later stages the top wilts and dies. A strong, sour odour is given off from the diseased portions of the stem when it is cut open.

In the fields under observation the rot was never found at the base of the stem, but commenced some 3-4 internodes from the base, and extended upwards through some 6-8 internodes. Preliminary investigations made by Mr. Leece in the Brisbane Laboratory indicate that the disease is caused by a fungus which probably gains entry through a wound. In two series of analyses carried out at the Isis Central Mill and the Bundaberg Experiment Station diseased sticks averaged a little more than one unit of C.C.S. below healthy canes from the same stools.

Internal stem rots of sugar cane are, as a rule, associated with over-maturity of the cane or pronounced weakening of the plant by drought, etc. Accordingly, several series of C.C.S. and maturity tests were carried out on healthy canes growing in affected fields; these tests provided strong evidence that the cane was over-mature, especially in that portion of the stalk attacked. At present, therefore, we incline to the opinion that the disease makes its appearance only on cane which has passed the peak of maturity, and is more common this year as a result of the excessively dry spring tending to produce earlier maturity.

The variety P.O.J. 2878 has attained prominence in the Bundaberg-Isis district on account of the fact that it can be harvested as a two-year-old crop. It thus possesses the virtues of an early maturing cane, and contains a high sugar content early in the season. However, it must be recognised that a crop which attains maturity at the beginning of a normal season may, indeed, be over-mature in July-August in a dry season. Fortunately, the time of maturity of any crop can be considerably delayed by the judicious application of sulphate of ammonia at the right time, and this point should be borne in mind by any grower who intends harvesting a fair proportion of standover cane. A spring application of sulphate of ammonia to one-year-old cane which it is intended to stand over will both delay maturity and improve the tonnage yield. Therefore this treatment of at least a part of the cane which is to be stood over will enable the farmer to harvest the whole of his standover cane at the peak of its maturity.

In order to obtain information regarding the effect of the application of sulphate of ammonia on delayed maturity and the amount of red stem rot in the variety P.O.J. 2878 it is proposed to set out an experiment involving the following treatments:—

No. 1.—Check, no treatment.

No. 2.—200 lb. sulphate of ammonia to be applied in October.

No. 3.—200 lb. sulphate of ammonia to be applied in October and a further 200 lb. in December.

No. 4.—200 lb. sulphate of ammonia to be applied in November and a further 200 lb. in January.

Maturity tests will be carried out in this cane during next winter and spring, while a close watch will be kept for the appearance of red stem rot.

Pineapple Disease.

A Cause of Poor Germination in Cane.

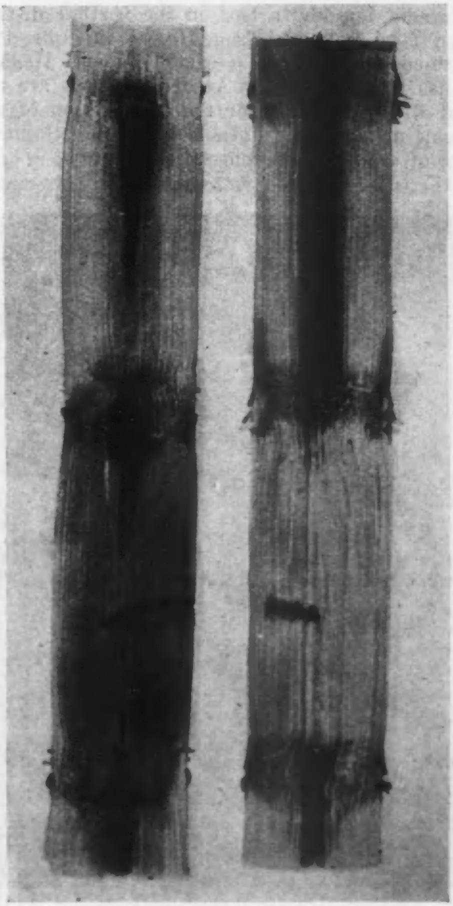
By A. F. BELL.

PINEAPPLE disease has not frequently been reported in Queensland, but particular attention was drawn to it some four months ago when it was an important factor contributing to the almost complete failure in germination of a sixty-acre planting in the Lower Burdekin district. It is possible that pineapple disease is responsible for considerably more bad strikes than are attributed to it; accordingly the symptoms are described and illustrated here in order that the disease may be recognised and reported to our field officers when it occurs.

Pineapple disease is caused by a fungus which also causes the water blister of pineapples, while a similar fungus attacks the banana. At times standing cane may be attacked, but for the most part it is a disease of cane setts which becomes infected after they have been cut. The first symptom which can be seen is a light-red discoloration of the internal tissues or "flesh" of the cane (see Fig. 16, A). Later, usually commencing at the cut surfaces, the colour changes to black, due to the production of the spores or "seeds" of the fungus. This

black colour frequently extends into the inner joints in the form of a sooty core (see Fig. 16, B). Perhaps the most striking symptom is the fact that when cut open many of the diseased setts give off a fruity odour very similar to that of a ripe pineapple.

Once the fungus has invaded the cane sett it soon penetrates to the buds and causes them to rot, thus prohibiting germination. Any condition which delays germination will tend to allow the fungus to enter and spread through the sett, destroy the eyes, and so ultimately prevent germination. Planting during weather which is too cool or too dry for a rapid strike, or placng too heavy cover on the setts, are among the conditions which tend to favour damage by this disease.



A B

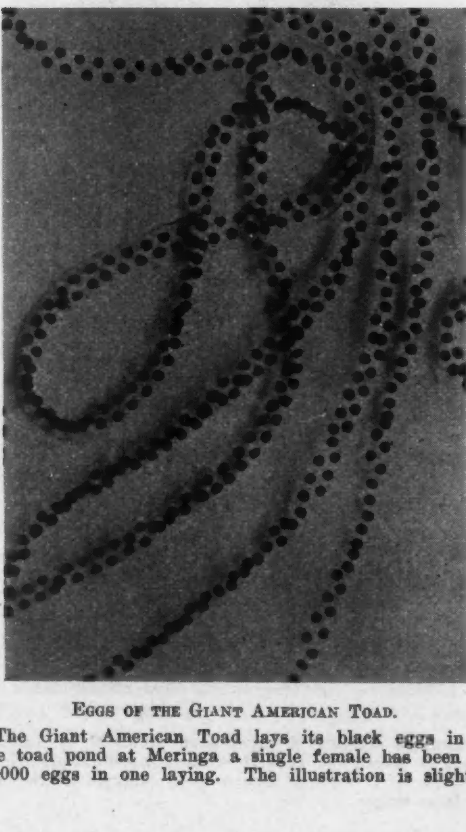
Fig. 16.—Pineapple disease of sugar cane produced by inoculation of setts. The lower part of A shows the general reddish discoloration of the flesh caused by the disease, while in B may be seen a good example of the sooty black core characteristic of later stages.

Considerable losses have been caused by pineapple disease, particularly in the British West Indies, where cane setts are sometimes soaked in Bordeaux mixture before planting as a means of control. Owing to its infrequently reported presence in Queensland, no control measures have heretofore been considered necessary, but investigations are being carried out at the present time in the pathology laboratory.

Removal of Ban on Release of Giant Toads.

It will be recalled that towards the latter end of last year the Federal Government imposed a ban on the further distribution of the Giant American Toad imported from Hawaii in June, 1935. We have now been informed by the Director of the Federal Health Department that this ban has been removed. Accordingly, we are now in a position to proceed with our plans for the distribution of colonies of the toad in such cane areas as are suitable for its development and where it is likely to be of assistance in controlling pests.

A.F.B.



EGGS OF THE GIANT AMERICAN TOAD.

FIG. 17.—The Giant American Toad lays its black eggs in long gelatinous strings. In the toad pond at Meringa a single female has been observed to lay upwards of 20,000 eggs in one laying. The illustration is slightly greater than natural size.

Spray Irrigation Trial in the Burdekin District.

By H. W. KERR and A. P. GIBSON.

IN the April, 1936, number of the Quarterly Bulletin, a description was given of an improved sprinkler which had been purchased for experimental purposes in the Burdekin district. A plan of the experimental field was given at that time, and it was stated that as a preliminary trial, the block of three acres had been subdivided, so that one half of the area received two acre-inches of water per irrigation, while the balance was given a three-inch application, the interval between waterings being the same in each case.

The spring and early summer of 1935 proved to be exceptionally dry, even for the Burdekin area, and it was necessary to adhere rigidly to the watering schedule which had been laid down. The following is a record of the water applications which the area received:—

1.	Furrow-irrigated	10th September, 1935
2.	First spraying	24th September, 1935
3.	Second spraying	18th October, 1935
4.	Third spraying	6th November, 1935
5.	Furrow-irrigated by grower, in error	17th November, 1935
6.	Fourth spraying	27th November, 1935
7.	Fifth spraying	6th December, 1935
8.	Sixth spraying	15th December, 1935
9.	Furrow-irrigated by grower, in error	28th December, 1935
10.	Seventh spraying	1st January, 1936
11.	Eighth spraying	11th February, 1936
12.	Ninth spraying	14th May, 1936

The soil varied from sandy loam to clay, and the variability in water-holding capacity was reflected in the growth of the crop. The varieties planted consisted of H.Q. 426 and B. 208, which somewhat affected the value of the trial from a yield viewpoint. During the period of the experiment heavy winds were experienced daily, and it was necessary to confine the watering almost entirely to the night hours.

It was early evident that the plot receiving 3-acre inches per watering would outstrip that to which 2-acre inches were applied. By the end of December, the more advanced cane commenced to lodge. Doubtless the experiment would have been more successful had the block been planted with Badila.

Good rains were experienced during March, April, and June, 1936, so that the watering schedule over the latter half of the growing season was accordingly modified, and a good crop was harvested.

Crop Yields.

At harvest time an area of approximately $\frac{3}{8}$ acre in each plot was marked off for yield purposes. This served to eliminate border influences from the adjacent plot. A record was kept of the area and total tonnage from the entire field of 10 acres, so as to enable a comparison to be made between the sprayed area and that which received furrow irrigation uniformly throughout. The harvest data are as follows:—

Treatment.	Cane per Acre.	C.C.S. in Cane.
	Tons.	Per cent.
2 acre-inches per spraying	43·4	15·0
3 acre-inches per spraying	55·3	14·7
Average, entire block (including sprayed area) ..	38·9	..

It is evident that the 3 acre-inch watering was superior to the 2 acre-inch during the season under review. Moreover, both sprayed plots compared more than favourably with the yield obtained from furrow irrigation throughout. The large crop on the sprayed plot receiving the heavier watering was badly lodged at harvest time, and the c.c.s. in cane was lowered from this cause.

Discussion.

It has already been stated that the chief objection to the spray irrigation method is the high initial cost of installation. But it is interesting to record that the method possesses the advantage of higher efficiency of water utilization, and consequently of economy in water consumption. In all, nine sprayings were given during the growing season, amounting to 27 acre-inches for the heavier application: to this must be added, say, further 10 inches, to allow for the furrow waterings given by the farmer. When it is remembered that some growers apply more than 80 acre-inches in the production of crops no heavier than that recorded here, it is obvious that large volumes of excess water are lost by percolation into the subsoil, due to the impracticability of applying uniformly a watering of 3 inches per acre.

The trial has been ratooned and refertilized, and it is hoped that our study of the ratoon crop will throw some light on this problem, which has caused much concern to growers in the Burdekin area.

Subsidy on Fertilizers.

Advice has been received that the Federal Government's subsidy on artificial manures, which has been granted during recent years, will be continued for the 1936-37 season.

The rate of subsidy has, however, been reduced from 15s. to 10s. per ton of fertilizer used.

H.W.K.

The Rind Hardness Machine and Its Use.

By R. W. MUNGOMERY.

ONE of the methods employed by agriculturists in reducing or warding off insect attack is the growing of more resistant varieties. These so-called "resistant varieties" usually prove resistant because they possess one or more characteristics which render them unattractive to a particular insect, through being unsuitable to this insect as a source of food, for egg-laying, or for the development of some of its early stages. Therefore, these resistant varieties are usually avoided by those insects which would normally attack them if they did not happen to possess some repellent attribute.

The factors which cause some insects to avoid certain plants may include hairyness of the leaf, thickness of the seed coat, the presence of certain essential oils, or hardness of the stem. Again, the plant may possess remarkable vigour which quickly brings it past the stage when it is susceptible to attack. Whatever these factors be, plant breeders constantly seek to breed them into new varieties in order to confer upon them resistance to particular pests.

Even the most casual observer in South Queensland will have noticed that the sugar-cane variety, H.Q. 285, was frequently attacked by foxes, whilst other varieties, such as Q. 813 and D. 1135, growing alongside, were consistently avoided. In the same way in North Queensland, growers also recognise the fact that much of their rat-eaten cane consists of Badila and Clark's Seedling, whilst some of the other varieties do not suffer such serious damage.

Now, although the damage caused by foxes and rats is particularly noticeable, that caused by the beetle borer is not so obvious, but it is nevertheless just as real, and during harvesting operations ample evidence is seen of the damage caused by this pest. Exactly in the same way it will be seen that certain varieties, such as Badila, Clark's Seedling, and Pompey, are prone to borer attack, whilst other varieties, such as H.Q. 409 and D. 1135, growing under similar conditions, show greater resistance and therefore less damage. We naturally ask, then, why is one variety more resistant than the other? That is, what factor or factors give the one set of varieties comparative freedom from attack, whilst the other set show serious damage?

The problem of assessing the relative value of these various factors is not so easy as it might first appear, but undoubtedly one of the chief reasons for this resistance to beetle borer attack is the greater hardness of the rind. Beetle borers not only find great difficulty in boring through the rind to insert their eggs, but also some of the young borer grubs, which may chance to hatch out, find conditions unsuitable for their development, and many of them perish. Thus, the pest does not multiply rapidly in these hard-rind canes, and consequently crops of these varieties carry only very light infestations and suffer a minimum of damage.

Obviously, in some of the wetter districts where climatic conditions prove so favourable for the borer pest, it would seem desirable to replace some of the older susceptible varieties with more resistant varieties, always provided, of course, that the new canes were equal or superior in yield and disease resistance to the older ones.

New varieties are being tested in different districts from year to year, but their resistance to borer attack cannot usually be determined until they have been grown in the midst of bad borer infestation. The severity of borer attack varies from year to year, and in this way a variety which otherwise shows promise, might in the normal course of events be grown fairly extensively before it is exposed to intense borer attack. If it finally fails through not standing up to borer attack, much time has been wasted in growing and testing it in any district which is badly borer infested. Now if we could determine in advance how a variety is likely to react to borer attack, we would be in the happy position of being able to omit from our varietal trials those canes which we are reasonably certain would fail on account of their extreme susceptibility. At the same time we could give the grower the assurance that under normal conditions, any new cane under test would be equal or superior to the standard variety from the point of view of borer resistance.

This is virtually what the rind hardness machine is designed to help us to do, and it is hoped that this new acquisition to our Meringa Laboratory will assist us in finding desirable canes for those districts where the borer problem has been so acute in the past.

The accompanying photograph (Fig. 18) illustrates the machine; briefly it consists essentially of a solid brass base, about 9½ inches in diameter, into which are screwed two upright steel columns about ⅝-inch in diameter and 17 inches high. Attached to the upper part of these columns is an adjustable bridge (position variable according to the thickness of the cane to be tested) which carries the piercing mechanism, and the indicator hand and scale. Lower down, these columns act as guides for another movable bridge which is actuated by an operating wheel into which is screwed a ¼-inch pitch square thread. This allows the lower bridge to be raised or lowered as required. On this lower bridge are fixed two opposing pieces of metal, which have V-pieces cut out of them, and provide a rigid support for the portion of cane to be tested. The needle which pierces the rind of the cane is of the same diameter throughout its entire length, namely 1/25 inch; it has a square blunt end.

The mode of operation is as follows:—The cane to be tested is placed on the lower bridge, and the operating wheel turned round steadily by hand at approximately the same speed throughout. This has the effect of raising the cane at a uniform rate towards the needle. When the cane first makes contact with the blunt needle, it is not pierced, but the needle is pushed upwards against a spring which is brought into tension and, at the same time, the upper portion of the rod which holds the needle operates the indicator arm. The indicator arm is screwed just sufficiently tight to prevent any loose movement, yet not tight enough to exert any undue pressure against the spring when the rod starts the indicator arm moving. A point is ultimately reached when the tension on the spring is sufficient to make the needle

puncture the rind, and when this happens, the needle suddenly punctures the cane for a distance of $\frac{1}{4}$ inch, leaving the indicator arm free and registering on the scale the tension exerted.

As the rind hardness of any one variety varies considerably in different sticks and in different parts throughout the same stick, a number of sticks are tested and the readings recorded. The requisite number of readings may vary from 250-500, and from these, the average tension can be determined.

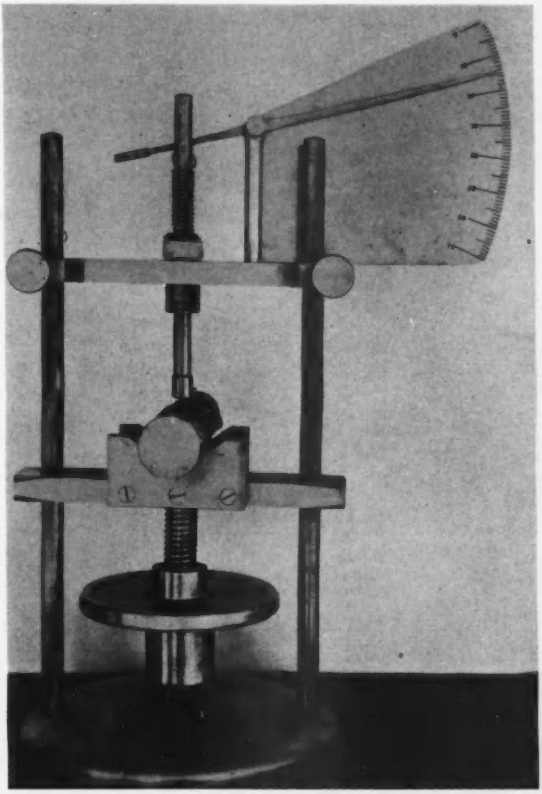


FIG. 18.—Illustrating the rind hardness testing machine.

It is usual to test the rind hardness of a borer-susceptible and a borer-resistant variety, and accept these as standards for comparison. Then, when testing a new cane, one or more of these standard varieties must be grown with it under the same set of conditions and, by taking tests with the rind hardness machine on the new variety, in comparison with the standard varieties, it is possible to forecast fairly accurately the new variety's reaction to borer attack.

Our machine is modelled on one which is in use by the Entomologists of the Hawaiian Sugar Plants' Experiment Station, and which was constructed under the supervision of Dr. H. L. Lyon, Director, to whom our acknowledgments and thanks are due.

Sugar at the Royal National Show.

THE sugar display presented at the recent Brisbane show was arranged by the sugar organisations, in collaboration with the Bureau of Sugar Experiment Stations. The accompanying illustrations depict the main feature of the exhibit, which was probably the most representative yet prepared. The central feature of the exhibit

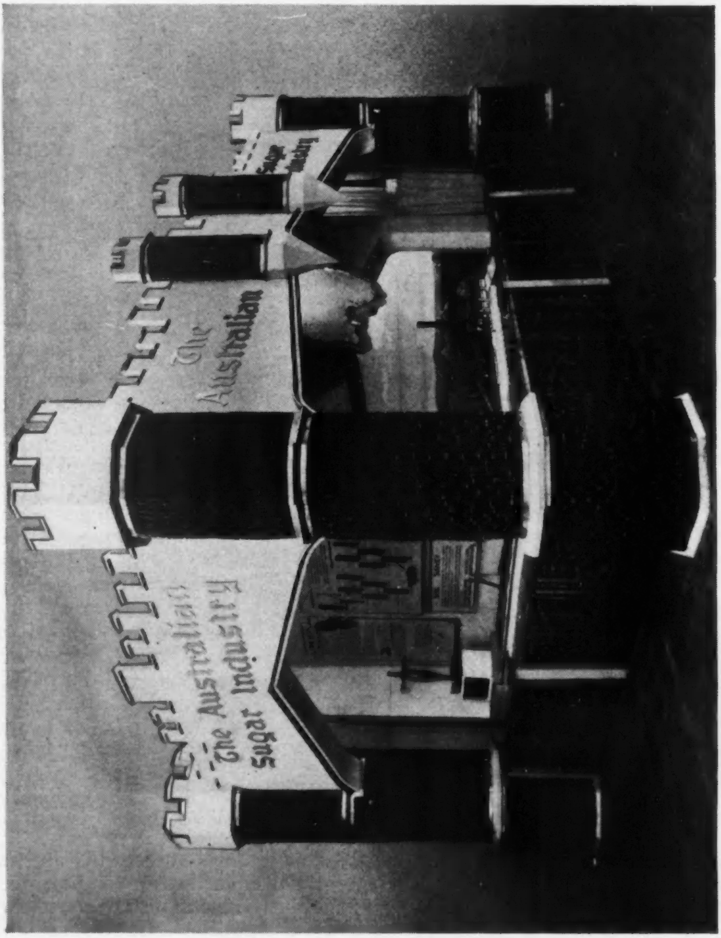


FIG. 19.—Full view of the central display presented by the Sugar Industry at the Brisbane Show.

was the display presented earlier in the year at the South Australian Centennial Exhibition. In addition, a subsidiary stand demonstrated the wide range of manufactured products of which sugar is an important ingredient, while the district cane exhibit provided the best display of sugar-cane seen at the Brisbane show in recent years. Thanks are due to those who assisted by sending along such excellent specimens

of produce from their respective districts. It is unfortunate, also, that other important cane districts were not sufficiently interested to ensure that they be represented, and the competition therefore lost a deal of its interest.

The exhibit was this year staged in the John Reid Industrial Hall, together with several other displays of an educative character. Doubtless, the sugar industry should be housed permanently in its own special building. It is, after all, the greatest industry of the State, and should occupy a worthy position at the annual State show. Similar sentiments were expressed by His Excellency the Governor, in the course of an address delivered at the Exhibition, and it is sincerely hoped by those associated with these annual displays, that this will be accomplished before the 1937 show. Though it is frequently suggested that Queenslanders are already well-informed on sugar matters, one has only to spend a little time in association with such a display, to learn that the ignorance of the Brisbane public in this regard is virtually as profound as that of the average Southerner. The industry should, therefore, recognise it as a duty to educate our own State dwellers, as well as those further afield, on the true facts of sugar production.

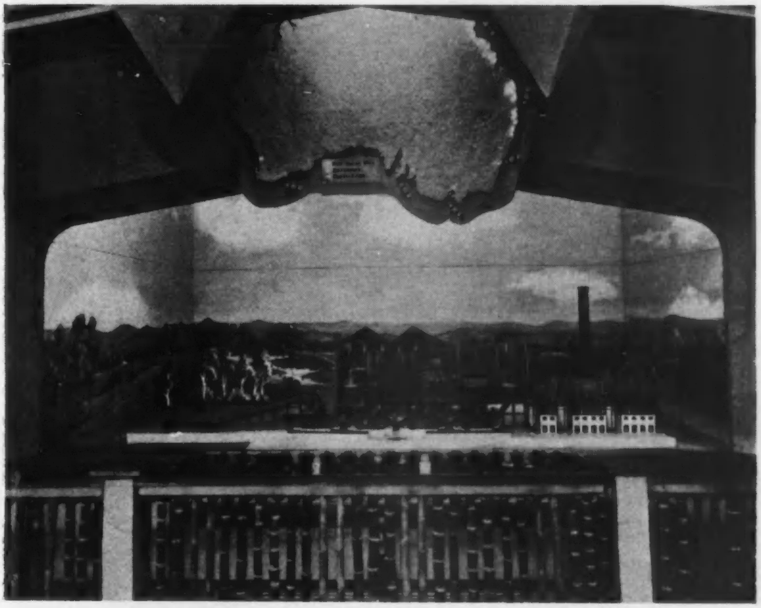


Fig. 20.—Illustrating the Model Sugar Mill and farming landscape.

A recorded description of the recent exhibit was broadcast at frequent intervals throughout the show, and this feature proved a valuable adjunct to the court. It enables the process of cane production and sugar manufacture to be presented in a concise and complete manner, while it permits of the presentation of many useful facts which are not so well appreciated as one might desire.

The following are the awards for the District Exhibit Competition, together with the prize-winning districts in the individual competitive classes:—

DISTRICT COMPETITION.

1st Prize: Burdekin District—

Six sticks each of Badila, E.K. 28, and B. 208; 1 stool of Badila.

2nd Prize: Cairns District—

Six sticks each of Badila, S.J. 4, and Clark's Seedling; 1 stool of S.J. 4.

3rd Prize: Bundaberg District—

Six sticks each of P.O.J. 2878, P.O.J. 2725, and M. 1900; 1 stool of Co. 290.

FIG. 21.—Showing portion of the excellent cane submitted for the District Cane Competition.

COMPETITIVE CLASSES.

Burdekin District—

1st prize, Collection of varieties.
1st prize, Stool of cane.
1st prize, Badila under 18 months.
1st prize, Cane under 16 months.

Cairns District—

1st prize, Any variety Queensland seedling.
2nd prize, Stool of cane.

Bundaberg District—

1st and 2nd prizes, Cane grown on red soil.
1st prize, M. 1900 Seedling.

Mackay District—

1st prize, Cane other than Badila, D. 1135, and M. 1900 Seedling.
2nd prize, Collection of varieties.
2nd prize, Badila under 18 months.

Proserpine District—

2nd prize, Cane under 16 months.
2nd prize, Any variety Queensland seedling.

Moreton District—

2nd prize, Cane other than Badila, D. 1135, and M. 1900 Seedling.

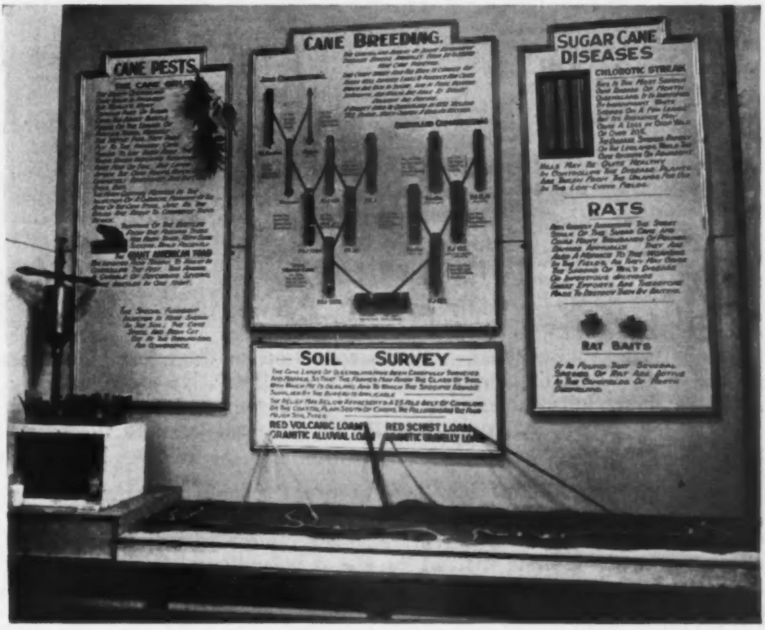


FIG. 22.—A glimpse of the work carried out by the Bureau of Sugar Experiment Stations.

Alternative Crops for the Canegrower.

By H. W. KERR.

THE canegrower is constantly reminded of the dangers which beset the farmer who is entirely reliant on one crop for his livelihood. At the present time excess sugar production, which results in the disposal of a large proportion of the crop at a value below production costs, renders it more important than ever to seek for alternative crops, for which there exists a ready market, and thus relieve the pressure which at present threatens the existence of many of our growers.

Another aspect of this problem is one which affects the future of Queensland agriculture in its broadest sense. Doubtless the arable lands of our coastal plain must ever constitute the most valuable agricultural areas of the State, and the future of primary production in Queensland appears bound up in the intensive development of this limited tract. Despite popular supposition to the contrary, the major proportion of these good-quality lands has already been brought under cultivation, while the best of these are devoted at the present time to cane culture. The value of intensification of production in reducing unit costs in a country which demands a living wage for its workers, has been repeatedly demonstrated; and a broad review of the question along these lines suggests a solution of the canegrowers' problem, while providing a brighter outlook for the general agriculture of the State.

Due to the uncertainty of rainfall incidence, even in parts of this comparatively humid coastal plain, intensive methods cannot be initiated successfully without the aid of irrigation. What can be achieved where adequate water is available is exemplified by recent developments on the large sugar plantations of Southern Queensland; and results have demonstrated that while assuring the desired crop, production costs are also reduced. By the full development of all available irrigation resources in these districts, similar results could be achieved on substantial areas of the coast. Production control could then be effected with safety and certainty, and it is reasonable to predict that with the assistance of irrigation, the acreage now devoted to cane on such areas could be more than halved, with no reduction in crop harvest. The release of this area of good-quality land for alternative crops, also by irrigated methods, would serve to provide the outlet for an increased farming population, and the relegation of marginal lands to their true position in the economic scheme.

As an illustration of how such a project could be brought into operation, we might consider the red volcanic soils of the Woongarra area, Bundaberg. Some few years ago, serious consideration was given by the growers of that district to the development of an ambitious irrigation scheme, whereby water from the Burnett River would be diverted to this area. As is general with all large irrigation schemes, the initial installation cost would be high, though it was estimated that water could be delivered to all farms in the benefited area for approximately £5 per 1,000,000 gallons. The proposal was finally rejected on the grounds that intensification of cane production would but lead to

further embarrassment, as the average crop production under natural rainfall conditions is sufficient to supply "peak" crops to the local mills. Apparently, little or no consideration was given to the possibilities of other crops.

At this time, a small irrigation plant was installed at the Bundaberg Experiment Station, for the purpose of studying irrigation problems on the red volcanic soil, and allowing us to gather information regarding the possibilities of intensive production on this valuable soil type, of which the chief drawback is its low water-holding capacity and droughtiness. Our cane experimental plots have already demonstrated the true potentialities of the land, when the natural soil moisture deficiency is overcome, and no difficulty is experienced in the economical production of a 60 or 70-ton crop of cane in sixteen months.

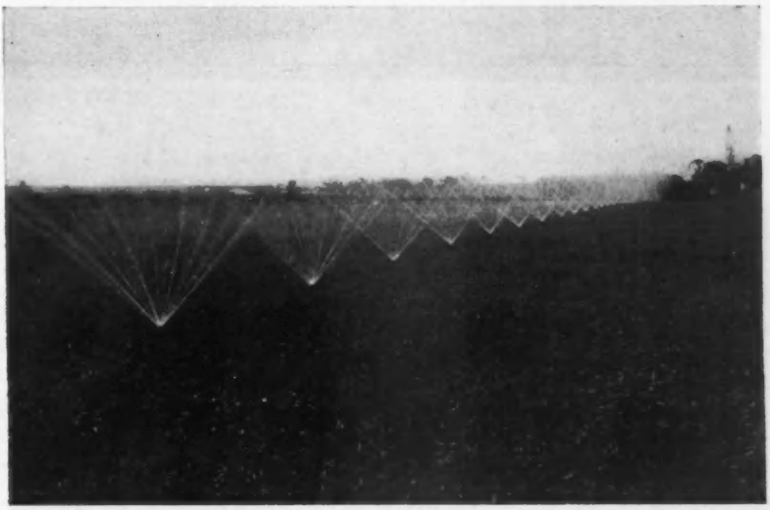


FIG. 23.—Operation of the spray system recently installed for the irrigation of lucerne.

Attention was then turned to the possibilities of lucerne production, by watering. For years a lucerne block had been maintained on the station under dry land conditions, and we were generally well supplied with hay for our station horses; but by the use of a spray irrigation system (see Fig. 23) some very interesting results were recorded during the past year. The old block was ploughed out, and after thorough preparation, was reseeded in April, 1935. A good stand resulted, and the first cut was made in August. This was allowed to lie on the field. Thereafter the block was irrigated as frequently as required, and cut

whenever the crop had attained the desired growth stage. The following table summarises the history of the field for the year:—

Irrigated.	Crop Harvested.
	1. October 2nd, 1935.
1. November 13th, 1935	
2. November 26th, 1935	
3. December 8th, 1935	
	2. December 16th, 1935.
	3. January 28th, 1936.
4. February 3rd, 1936	
	4. Half February 18th, 1936.
	Half March 11th, 1936.
	5. Half April 6th, 1936.
	Half April 14th, 1936.
	6. Half April 14th, 1936.
	Half May 18th, 1936.
5. May 28th, 1936	
6. July 17th, 1936	
	7. Half July 29th, 1936.
7. August 7th, 1936	
	Half August 19th, 1936.

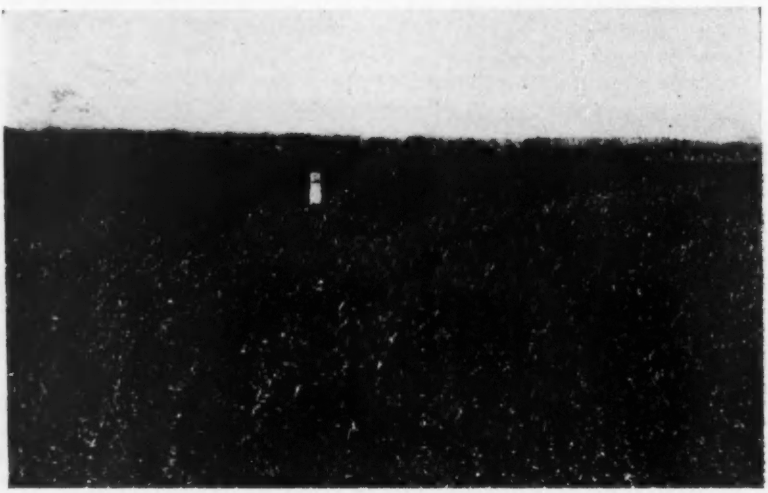


FIG. 24.—A fine stand of lucerne on the Bundaberg Station.

In the first year of the stand it was therefore possible to harvest seven cuttings of lucerne, while seven waterings, each of 3 acre-inches, were given. It will be remembered also, that the past season was notable for its rainfall deficiency. Yield determination showed that somewhat more than 2 tons of *hay* per acre were obtained at each cutting, or a total of 15 tons per acre for the year. It should be pointed out that at no time was an attempt made to force growth to its limit, due to the superabundance of hay on hand, at all times, for horse feed. It is the opinion of Mr. N. J. King, who is in charge of this project, that no difficulty will be experienced in the coming year in producing 20 tons of hay per acre.

FIG. 25.—Windrowing with the side-delivery rake.

The method of handling the crop is illustrated in Figs. 25 and 26. The cost of handling the hay is substantially reduced by the employment of the side delivery rake in windrowing. Though the implement has also proven useful in cocking, it is found that this operation is best effected by hand.

FIG. 26.—The cured hay ready for transfer to the barn.

One must conclude, from the above results, that the red volcanic loam of the area is a first-class lucerne soil under irrigated conditions. At average market values for the hay, the gross return per acre would be in excess of £100 per annum, while in the absence of a market for the quantity of hay which might be produced, the development of a stock-fattening industry offers considerable promise.

The production of fat lambs, for example, is an industry for which a ready market is assured, both in Queensland and overseas. It is, therefore, of interest to examine the prospects which such a project would offer, when combined with canegrowing. For it provides a ready means of disposing of crop refuse (green tops), and a mill by-product (molasses) in a much more economical manner than it at present possible on a wide scale. It is suggested that the production of cross-bred lambs, by mating, say, a Dorset Horn ram with Merino ewes, would be productive of the best results under these conditions. The ration for the breeding ewes would be substantially lucerne hay, supplemented by cane tops (when available) or grass for roughage, and with the addition of molasses to supply any deficiency in carbohydrates. The lambs would be fattened rapidly on a similar ration, and marketed at the age of four-five months, when they should yield a dressed weight of from 30-32 lb. On dry land such as this, foot trouble and coastal parasites should be at a minimum, while with small flocks it would be practicable to deal readily with any complications from these causes. Should it be found undesirable to retain the ewes for more than a limited period, both ewes and lambs could be fattened and marketed.

In considering the cost and returns from such a scheme, the cost of labour has not been considered in detail. Doubtless, this would vary with the handling facilities available; but the following estimates of out-of-pocket expenses are presented to indicate the margin which the project offers. Costs are calculated on the basis of 100 ewes, producing eighty lambs.

Feeding costs.

Allowing 750 lb. lucerne hay per ewe per annum—

One hundred ewes will require 34 tons of hay; supplemented by 50 tons of cane tops, &c., as roughage, which would be yielded by 200 tons of well-grown cane.

Adding molasses to the above at the rate of ½ lb. per day, 8 tons of molasses would be required.

Allowing an average of 1 lb. lucerne hay per lamb per day, for four months—

Eighty lambs will require 4½ tons hay.

A molasses ration of ⅓ lb. per head per day, would consume 1½ tons molasses.

Summary.

	Tons.
Total lucerne hay	38½
Total cane tops, &c.	50
Total molasses	9½

Allowing £6 as the cost of 1,000,000 gallons of irrigation water, one half million would be used per acre per annum, at a cost of £3. On the basis of the lucerne yields suggested above, 2 acres would be necessary to supply the required hay. The cost of water would then be £6 per annum. For molasses, a value of £1 per ton, on the farm, might be allowed.

Summary of Above Costs.

Lucerne irrigation	£6
Molasses purchased	10
Fertilizer for lucerne block	5
	£21

Cost of marketing must also be added.

Return from Ewes and Lambs.

Eighty lambs at 20s. each	£80
Wool from 100 ewes at 8s.	40
Profit, from sale of fat sheep, at 4s. per head	20
	£140

In addition to any income which would be derived from this source, it must be borne in mind that the utilization of cane tops and molasses as feed would result in the economic disposal of these by-products, while the droppings voided by the animals would contain a large proportion of the plant-food materials contained in the feed, and would constitute a valuable manure for the cane lands.

It should be emphasised that the above suggestions are presented, not as a cure for the ills of excess sugar production, but merely as a line of thought which should interest those of our growers who are earnestly seeking some way out of our present difficulties. Moreover, while such schemes might be of value in the drier cane areas, the problem of the humid north offers greater difficulties.

Does Manuring Pay?

By H. W. KERR and G. BATES.

SO many of our canegrowers have long known the absolute necessity for the use of fertilizers, if they are to maintain the productivity of their land, that the above question would to them appear superfluous. But there are a number of farmers who have still to learn the true value of these sources of plantfood, as an aid in reducing costs of production, and in restoring fertility to the land; and it is to those growers that we would present the striking results obtained from a fertility trial conducted on the farm of Messrs. S. J. Page and Son, of Edmonton, North Queensland.

This trial has now been continued for four years, and full yield data are available for the plant and three ratoon crops. The soil type is rather poorly-drained schist loam, which was producing inferior crops at the time the present owner entered into occupation. The use of the mole-drainer and tractor-grubber, combined with good husbandry, has so improved the general condition of the land, that it is able to maintain good cane tonnages, *provided it is supplied with the plant-foods which it so seriously lacked in its initial state.*

The land was considered as suitable only for the growth of Pompey, which variety was planted accordingly. The block had received a thorough preparation prior to planting. The trash from the old ratoons was ploughed under, and crushed limestone was broadcast at the rate of 2 tons per acre. A heavy crop of legumes was subsequently grown and turned into the land. Finally, the field was deeply grubbed just before the cane was planted.

The fertilizers applied on the experimental areas consisted of combinations, in pairs, of the following:—

N—420 lb. sulphate of ammonia per acre.
P—270 lb. superphosphate per acre.
K—150 lb. muriate of potash per acre.

One series of five plots received the full fertilizer application, amounting to 840 lb. of mixed fertilizer per acre, while a further set was given no manure of any kind throughout the experiment.

The crop yields for the four years were as follows:—

Crop Yields, 1933-1936.

Crop.	No Manure.	Sulphate of Ammonia + Superphosphate.	Sulphate of Ammonia + Muriate of Potash.	Superphosphate + Muriate of Potash.	"Complete" Fertilizer.
	Tons.	Tons.	Tons.	Tons.	Tons.
Plant cane	28·2	31·3	34·4	34·8	37·0
First ratoon	13·4	22·6	26·8	17·5	29·6
Second ratoon	11·9	21·6	22·9	13·4	25·5
Third ratoon	13·2	23·1	29·9	15·9	32·9
Total yield—4 crops ..	66·7	98·6	114·0	81·6	125·0
Average yield per crop ..	16·7	24·7	28·5	20·4	31·3

Discussion of Results.

The above results present certain striking features. Following good preparatory treatment of the land—not overlooking, of course, the green manure crop—the unfertilized land yielded quite well, though the benefits from the manure on the fertilized plots were already evident. The value of the early treatment had, however, entirely disappeared

before the growth of the first ratoon crop. The serious lack of available nitrogen, in this humus-deficient soil, was a very potent factor in rendering the unfertilized ratoon crops almost a complete failure, while superphosphate and potash also exerted their influence on the "complete" manure plots.

This low level of productivity on the unmanured area persisted throughout the trials, though the fertilized plot yields reflected the seasonal climatic conditions. The beneficial growing season just experienced resulted in a third ratoon yield of almost 33 tons per acre, where the land was suitably fertilized, while the unmanured crop was but $1\frac{1}{2}$ tons in advance of the second ratoon yield of 1935. The trend of yields due to the several treatments is strikingly illustrated in the accompanying graph (Fig. 27).

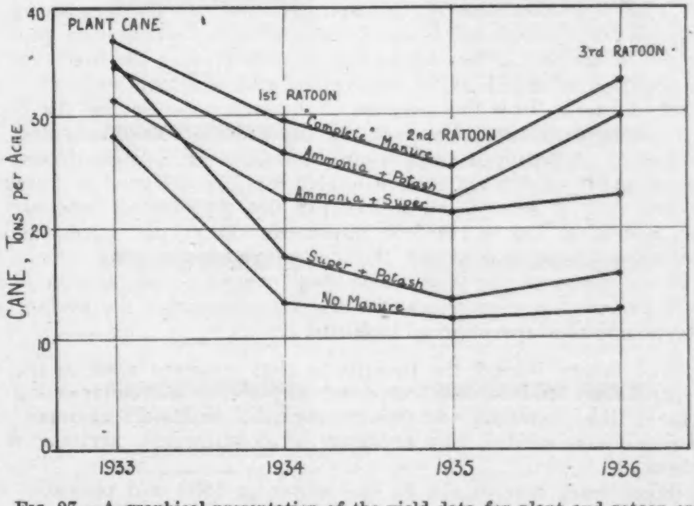


FIG. 27.—A graphical presentation of the yield data for plant and ratoon crops.

Finally, a study of the average yields for the four crops show that the unmanured cane yielded 16·7 tons per acre, while the fully-fertilized crop gave an average of 31·3 tons per acre.

Recommendations.

The above returns indicate very clearly the natural deficiencies of the schist lands of North Queensland, where they constitute a major soil type. Profitable crop yields will be obtained only where due regard is paid to the plant-food applications given in the form of suitable artificial manures. An initial application of 4 cwt. per acre of Sugar Bureau No. 2 or No. 3 Mixture provides the crop with an abundance of phosphate and potash, and subsequent top dressings of sulphate of ammonia (up to 4 cwt. per acre for ratoons), supply the necessary available nitrogen in which the land is so seriously lacking.

It should not be necessary to stress that on soils of this character, the benefits from green manuring during fallow are strikingly reflected in plant cane growth, and incidentally, eliminate the need for heavy manuring with sulphate of ammonia for that crop.

Does Cultivation Conserve Soil Moisture?

By N. J. KING.

THERE are four means by which moisture may be lost from the soil:—(1) drainage, (2) transpiration through the cane leaves, (3) transpiration through weeds and grasses, and (4) evaporation from the surface of the soil. The farmer has no control over the first two, and the third is attended to by cultivating and chipping until the cane is out of hand. It is the purpose of this article to discuss the fourth —evaporation losses. Farmers for generations have adopted the practice of preparing a surface mulch to prevent moisture losses, and a great many of our cultivation implements are designed to break up the first inch or two of soil and so produce the desired loose surface. This operation has a two-fold object—in destroying weeds and in creating the loose mulch with the idea of moisture conservation. But there are times of the year when weed control is not necessary, and yet after rain the grower scarifies the farm to mulch the surface and prevent undue evaporation of moisture.

The theory behind the practice is that moisture rises in the soil by capillarity and is evaporated by sun and wind on reaching the surface; the mulching, by destroying the capillary channels and forming a loose surface, thus prevents the moisture from arriving at the surface.

Some work carried out by the writer in 1933 had indicated that the upward movement of water by capillarity on the Woongarra soil was practically nil, and this observation prompted the investigation as to whether surface cultivation was of any value in preventing evaporation.

An experiment was initiated to obtain information on this point. Portion of a block under bare fallow was divided into four portions. Section (1) was hand hoed to a depth of two inches to maintain a surface mulch; section (2) was left bare—just as flattened down by the rains—but weeds were hand picked to maintain comparable conditions with (1); section (3) had a close cover of corn sacks in an attempt to prevent surface evaporation altogether; and section (4) had a cover of trash to measure its efficiency as a mulch as compared with the sack and soil mulches. Borings were carried out on these four sections every two or three days to a depth of four feet, and the moisture determined in 3-inch and 6-inch sections over the total depth. The experiment was started immediately after the April rains and continued until 2nd May, during which period no rain fell.

It is noticeable in examining the results (Fig. 28) that the soil under the sack cover lost the least moisture by surface evaporation. The complete table of results obtained shows that very little difference exists between the bare surface plot and that which had a hoed surface. In fact the aggregate of all determinations proves that slightly less moisture was present in the hoed plot than in the other, due to the more rapid drying out of the surface two inches of mulch. The plot under the trash cover retained, on the whole, slightly more moisture in the surface two feet than that under corn sacks.

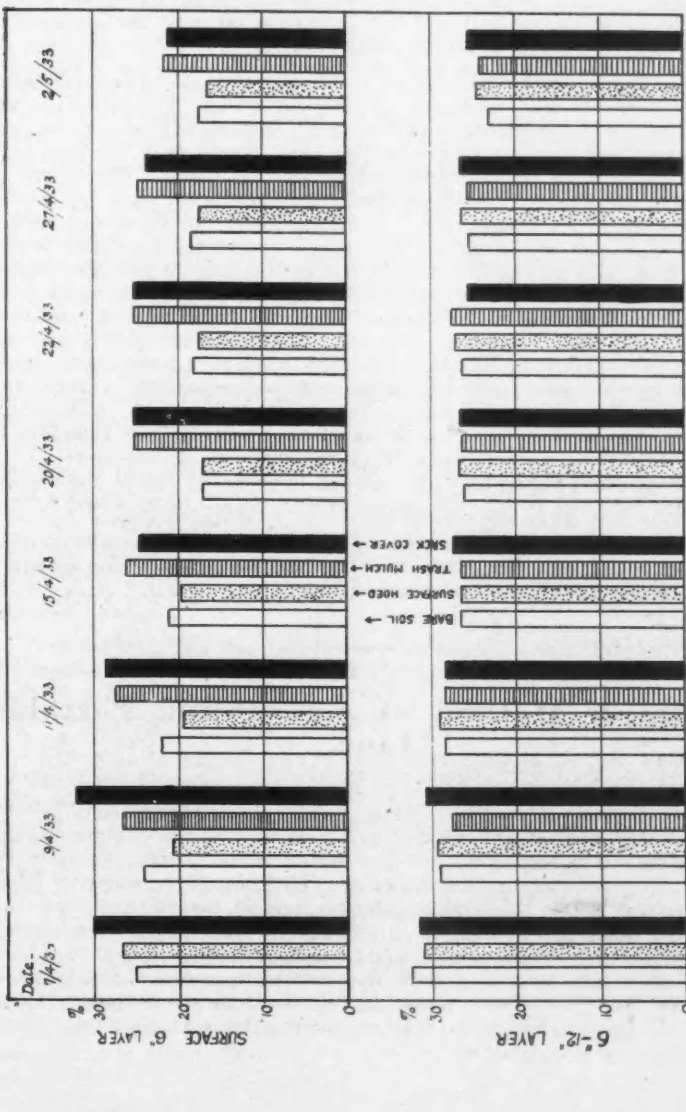


FIG. 28.—A selection of the soil moisture data presented in graphical form. The influence of soil treatment is particularly noticeable in the surface 6″ layer.

Two outstanding facts are discernible from this work. The first is that surface scarification as a means of conserving moisture is valueless on this soil type, and is uneconomical unless weeds are sufficiently bad to warrant removal. The second is the decided advantage of the trash mulch in moisture economy. It has been mentioned to the writer that after rain on this and other soils the sun tends to form a crust on the surface, and that scarification is necessary if only to break up this crust. In the writer's opinion the only harm this crust can do is to prevent or render difficult the coming through of young shoots after planting. It is certainly recommended that the crust be broken at this stage to allow young shoots through, but later on even the breaking of the crust would serve no useful purpose.

The results of this study were so directly opposed to popular belief that it was thought necessary to confirm them. Consequently the experiment was repeated in October, 1933, with exactly similar results. Since then publications from overseas have shown that identical conclusions have been reached in other parts of the world. The theory of mulching to prevent moisture losses by capillarity was supported strongly by F. H. King and E. W. Hilgard some 40 years ago. Since then Veihmeyer in California, Rohmstroff in Odessa, Call and Sewell in Kansas, and the Office of Dry Lands Agriculture in Washington have all found that the loss of moisture is practically the same from mulched as from unmulched surfaces; in some of the cases the mulched surfaces lost more moisture. The apparently contradictory results are explained as follows:—(1) It is found that where a water table exists within approximately six feet of the surface, capillarity effects, and consequently evaporation losses, are high. (2) Where the water table is below the six-feet level the effect of capillarity is not sufficient to cause large evaporation losses from the surface. In example (1) a surface mulch produced by cultivation implements would reduce the moisture loss, but in (2) the surface mulch would be useless.

Not many Queensland cane soils have a water table within the first six feet, so that scarification *for the sole purpose of conserving moisture* must be considered an uneconomical procedure.

A Simple Method of Assembling Portable Line.

By D. L. McBryde.

A GOOD deal of portable line is purchased and assembled by the canegrowers of Queensland each year and, unless the assembling of the line is carried out by experienced labour, much unnecessary money must be spent in this direction. With a view to assisting those farmers who might be about to assemble line of the rivetted type, the following notes are written to set out an improvised method by which a 15-chain batch of line was handled. The rails were B.H.P. product, and their weight 14 lb. per yard, and details, dimensions, &c., must be taken as applying to this particular standard only. However, there would be little difficulty in making modifications which would allow the scheme to be applied to any type of rivetted rails.

An anvil was devised which would enable a pair of loose rails to be passed through special apertures, so that the two ends of each sleeper could be rivetted simultaneously to their respective rails. The anvil was set up in an horizontal position on heavy timber foundation, well bedded in the soil. On one side of this anvil, and at a suitable distance and height, a rail-bogey was placed, with wheels upwards, and on the opposite side to the bogey was placed an horizontal bar. The positions of this bar and the treads of the bogey wheels were such that they took the weight of rails as they were passed through the apertures of the anvil.

The above constituted our assembly-bench, and the procedure of operation was as follows:—Three men were employed in the gang, two of whom were rivetters, and the third had sundry points to attend to, to balance the team. Two rails were taken and placed, up-side-down, on the treads of the bogey wheels. One rail was taken by a rivetter and the third man; fish-plates were placed in position, the rail laid on its side with the rivet head resting on the anvil, and the rivet clinched. This rail was then carried across the anvil and the other end passed back through the aperture of the anvil. While this was being done, the second rivetter placed two rivets in the base-plate holes of his rail, slid the rail into the second aperture of the anvil and placed and rivetted the base-plate. The two rails were thus made ready for assembly at the same time.

A rivetter now took his place at each end of the anvil, and the third man at the far ends of the two loose rails. The rails were slid into the apertures of the anvil until the rivet-holes for the first sleeper were within an inch or two of the anvil. Each rivetter then placed the three sleeper rivets in his rail, passing them upwards with his right hand and holding them in position with the fingers of his left hand. The rail was then lifted by the two rivetters, so as to gain clearance for the rivet-heads to pass on to the anvil, the rails then being moved along by all three men until the rivets were all resting on the face of the anvil. A sleeper was then dropped into position, and the rivets clinched tightly.

Special attention was paid to the position of the rails before rivetting the first sleeper, and their ends were properly squared. The remaining sleepers were put on without further need for care in the above direction as the first sleeper held the rails firmly.

The rails were then slid through the anvil until the rivet-holes for the second sleeper were close to the anvil. Rivets were placed in their holes, the rails were lifted to place rivet heads on the anvil, the sleeper dropped on and rivets clinched, just as was done with the first sleeper, and the rail moved along, and so on until all five sleepers were attached.

The section was then passed along until the rail-ends were near the anvil, two rivets were put into the base-plate holes, and slid onto the anvil and the base-plate attached. This completed the section, except for the fitting of the second pair of fish-plates, and it was necessary to take the section out of the anvil, stand it on its side, with fish-plates and rivet in position and the rivet head on the anvil, to complete this attachment.

It is important that fish-plates and base-plates should be put on in a standard manner, so that any section will fit any other, no matter how the one is brought up to the other. To do this, it is necessary that a base-plate is fitted to the end of one rail and fish-plates to the same end of the other rail of the section. If a farmer is one of a group, and will be sharing line with the other members of that group, he should see to it that his standard of attaching fish- and base-plates is the same as that used by other members of his group, otherwise a good deal of trouble will be incurred.

Working on the foregoing system, after the gang had got the feel of their tools, and had worked up a satisfactory degree of teamwork, sections were put through in seven minutes, or faster than 2 chains per hour. There were, however, several causes of hitches in the flow of work which actually reduced the rate of output to but slightly more than 1 chain per hour for the whole 15 chains, and a mention of these causes of trouble would be of advantage to others who may adopt this scheme of assembly.

Firstly, the bench assembly was not sufficiently rigid to see the job through without loss of alignment on several occasions. This was partly due to the fact that we had built on newly ploughed land, partly to the rain which fell on the first working day causing softening of the foundations, and partly to the fact that we had not built the whole on common foundation slabs or logs. Secondly, the rain, mentioned in the above paragraph, caused much discomfort and inconvenience in handling rails, and added difficulties to the clinching of rivets because of wet and slippery hammers. Exposure to the weather could have been overcome by the erection of a skillion roof, or even of a tent-fly, but the smallness of our job, 15 chains, did not warrant such precautions. Thirdly, the dimensions of the anvil, which was made for the first experiment of this scheme, were not quite ideal, and the clinching of rivets was slower than need have been so that each was done strongly. Fourthly, a number of the rails were knocked about in transit and these occasionally caused jambing in the anvil. It would have been better to have examined all rails, and attended to all kinks before the assembly job was started, and not, as we did, try to take the kinks out when they caused jambs in the anvil.

On the basis of experience gained, the anvil recommended for this job may be described as follows:—

A bar of cast or wrought iron, or steel, not less than 3 feet in length, by not less than 3 inches in thickness and 4 inches in depth, is required for the anvil. The above are what is considered the minimum dimensions, and may be exceeded to any degree, except for the thickness, which could not exceed 4 inches without causing loss of usefulness in the resultant anvil.

Two holes are drilled in this block. These holes should be 1½ inches, or perhaps slightly more, in diameter. Their relative positions are 25⅜ inches apart (centres), more or less equidistant from the ends of the bar, and 2¼ inches (centre) from the face which is to become the surface of the anvil.

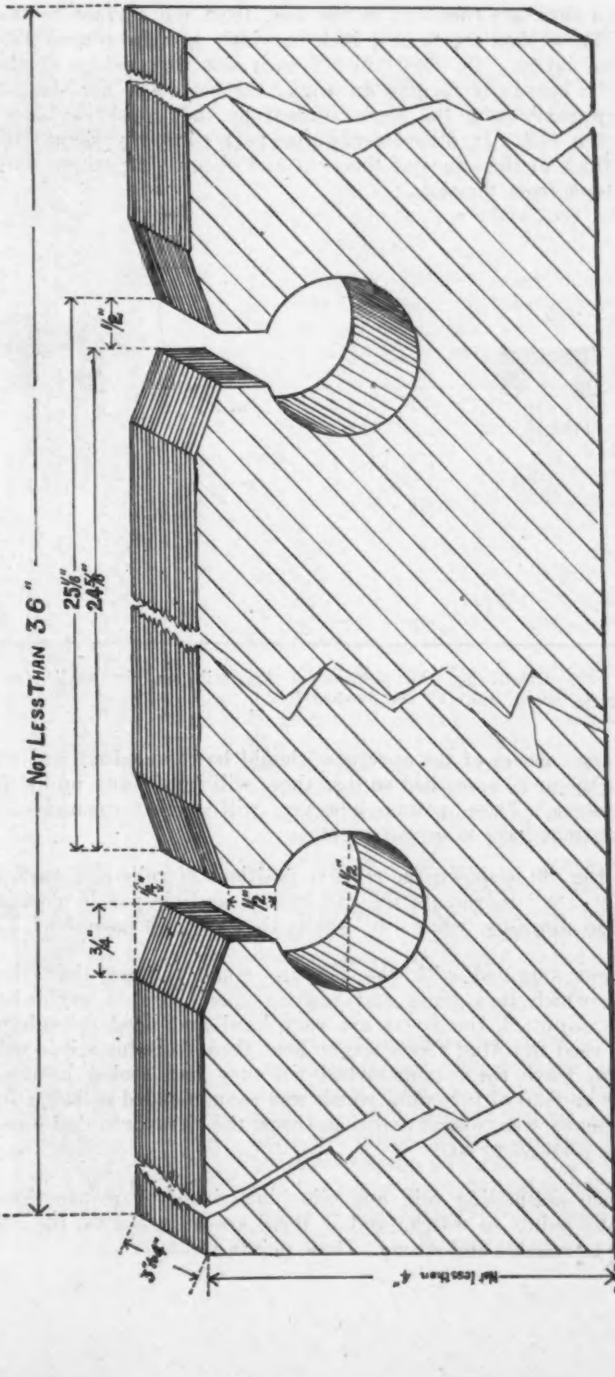


FIG. 29.—Showing full dimensions of the recommended anvil (see text).

Two slots are then cut in the bar, from the surface to the above holes. These slots are to be ½ inch in width, and are placed 25⅛ inches (centres) apart. On each side of each slot the surface of the anvil should be cut away to give an angle, the centre of the slot being its apex, approximating the angle formed by the upper surfaces of the tread of a rail. In other words, the part cut away should be about ¼-inch thick at the edges of the slots and should run out to nothing at ¾-inch back from the slots.

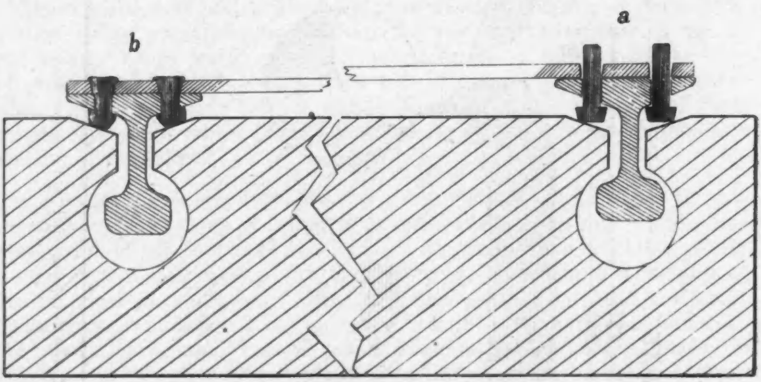


Fig. 30.—Illustrating the position of the rails on the anvil—(*a*) before clinching the rivets, and (*b*) the finished job.

Sharp corners of the apertures should be rounded off and adjacent faces of the anvil smoothed so that there will not be any undue friction at the start. These points, however, will correct themselves before many sections have been put together.

In Fig. 30 is shown the relative positions of rails and anvil during assembly; "a" represents the rail, rivets, and sleeper in position and ready for clinching, while "b" shows the same job assembled.

Rivets supplied with the job are much thinner than the holes through which they pass, and require much care to avoid bending. Also, as supplied, the rivets are very hard and need softening. The method used to soften rivets was to heat them to redness in a coke fire, and then leave them undisturbed till they had cooled in the ashes. Another method of softening which was recommended as being superior to that above, was to heat and then throw the rivets into dry lime where they are allowed to cool.

When assembling rail, and clinching rivets, there are three very important points to watch; and if these are attended to, the resultant job will be reliable and strong. These points are—

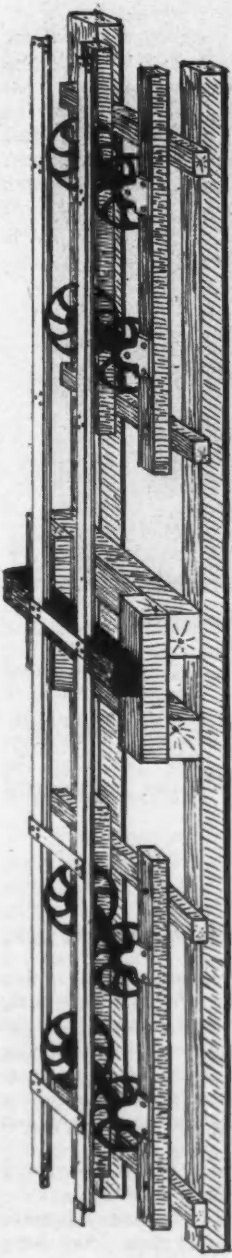


FIG. 31.—Illustrating the ideal assembly-bench for the riveting of portable line.

1. Rivet-heads *must* rest on the anvil and the weight of the rail *must* rest on the rivet-heads.
2. Sleepers and rails *must* make good contact when the rivets are being clinched.
3. The rivets *must* be swelled to fill all air-space in the holes in rails and sleepers when they are being clinched.

In Fig. 31 is shown what is considered to be an ideal assembly-bench for the rivetting of portable line. The details of the bench may be altered very considerably without departing from the principles involved.

The anvil is in the centre of the group, and the rail-bogeys, lying on their backs, are on either side of the anvil. Either or both of the bogeys may be replaced by crossbars supported by posts, but the bars should be of metal and not wood, so that friction is at a minimum. A pair of truck wheels mounted on posts on either side of the anvil would give better service than bars. The bogey wheels act as carriages for the rails before and during assembly of each section. Their elevation should be such, that when a straight rail is passed through either aperture of the anvil, and laid on the wheel-treads, the tread of the rail should be just clear of the anvil. This is important, as upon the correct setting depends the snug bedding of the rivets while being clinched. The anvil and carriages should be bedded on common foundation planks or logs, and these planks should be set on firm, level ground. All timber should be firmly bolted or spiked together, so that there can be no loss of alignment during the job.

Rivetting hammers of about 2 lb. weight are suitable, and the ordinary engineer's hammer is quite satisfactory. One bump with a seven, or ten, pound sledge-hammer saves much time, after the rivets have been brought well up with the lighter hammers, but the heavy hammer cannot be used with safety at first, owing to the danger of bending the long rivets.

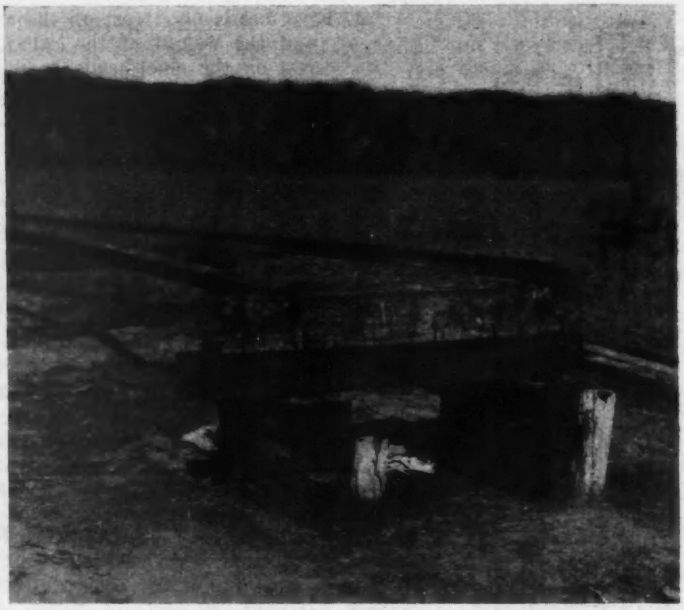


Fig. 32.—Photograph of the set-up employed at the Mackay Station.

The cost of making the anvil should be not more than £2, and the cost of the bar from which it is made would depend on whether it is specially cast for the job or is procurable from the scrap-heap. At most, the cost should not exceed £2, making a total cost of the tool not more than £4. If we reckon on turning out 1 chain per hour, the assembly of the first 8 or 10 chains would probably pay for the cost of the anvil.

Wireworm Damage in the Mackay District.

IN the July issue of the Quarterly Bulletin there appeared an article by Mr. W. A. McDougall (p. 10) in which he warned farmers that, as a result of the conditions prevailing during the past season, it might be expected that wireworm damage would be fairly extensive during this spring. The forecast has proved to be quite correct, and numerous reports have been received of bad strikes resulting from wireworm attack. In one case a planting of some 20 acres has had to be ploughed out.

Inspections of test plantings of cane setts in a typical low-lying block on the new Experiment Station indicated that wireworms were very active and their stage of development was such as to make it unsafe to plant before the end of September. These observation have been borne out by the experience of poor strikes in badly-drained fields on farms in the vicinity of the station.

Farmers are again warned that *now* is the time to set about controlling wireworm damage during *next season*, and the following quotation is taken from Mr. McDougall's article:—"In its early stages the young wireworm requires extremely wet soil conditions in order to survive, although it can later withstand very dry conditions. Therefore, in order to control the pest, the land must be bedded up and drained *before the commencement of the rainy season*, so that these excessively wet conditions cannot occur and the wireworm will perish in its early stages. This is the only known satisfactory form of control."

A.F.B.

Subterranean Waters of the Woongarra Lands.

Their Suitability for Irrigation.

By N. J. KING.

THE past four or five years have seen in Bundaberg the advancement of irrigation from an experiment to an outstanding commercial example of crop control. The large Bingera and Fairymead Plantations, with two basically different schemes of water production, have shown that successful irrigation of cane is just as practicable in the sub-tropical south as in the Burdekin delta. The refusal of the Bundaberg farmers (in the proposed benefited area) to be burdened with a community irrigation undertaking has left the onus on the irrigation-mined grower of developing an individual plant for his farm requirements. In the immediate Bundaberg district this involves the search for underground water, as very few farms have access to river water of the necessary purity.

A number of growers have already investigated the subterranean supplies on the forest lands of South Kalkie, Clayton, and Gooburrum; and in most of the cases which have come under the writer's notice, success has rewarded their efforts. The few cases where difficulty has been encountered have probably been due to unsuitable spears or failure to lodge the spears in the proper drift, but in no case has the water been unsatisfactory. It is the purpose of this article, however, to discuss the subterranean supplies of the Woongarra lands, as here the problem is a particular one, and one about which divided opinions are held by local growers. Space will not be taken up by discussing the suitability of the red volcanic soils for irrigation. This has been definitely proved, if proof were needed, by the few plantations and farms on which irrigation plants have already been installed. Rather is it proposed to show the suitability of most of our waters for irrigation.

As far back as 1905 Dr. Maxwell, then Director of Sugar Experiment Stations, carried out a water survey of the Woongarra area with a similar object in view. His report of 1906 contains some valuable and surprising figures in the light of the fact that the general current opinion regarding the underground water supplies is that they are

not fitted for irrigation purposes. Tabulated in his report are the following figures:—

No. of Waters.	Total Solids, Grains per Gallon.	Salt, Grains per Gallon.
	From—	From—
6	1 to 10	2 to 6
52	11 to 20	3 to 14
46	21 to 30	3 to 28
17	31 to 40	9 to 32
11	41 to 50	14 to 28
8	51 to 60	22 to 40
2	61 to 70	24 to 32
9	71 to 80	29 to 51
3	81 to 90	33 to 43
8	91 to 100	43 to 61
20	101 to 150	40 to 85
4	151 to 200	86 to 120
2	201 to 250	107 to 133
1	251 to 300	145
1	301 to 350	194
1	351 to 400	229
1	401 to 450	242
1	550 to 600	462
1	650 to 700	427

From the above 194 samples from wells on the Wongarra, 182 are considered suitable for irrigation *on the Woongarra soils.* Reasons are given below for this belief. It must be remembered that in 1905 the quality of these waters was probably as low as it had ever been, as four droughts had been experienced in the previous five years. Unfortunately we cannot accept the above tabulated figures on their face value. These wells, probably sunk for domestic or stock purposes, were in many cases shallow wells tapping only surface water. Similarly one cannot be certain that, if subjected to severe pumping test, the quality of the water would not change, becoming more or less saline. Another objection is that unless tested with a pump over a fair period, no idea of the amount of water available for irrigation could be obtained.

In 1933 the writer was instructed to carry out a similar survey of the then existing wells. A considerable amount of work resulted in a similar unsatisfactory position. From farm to neighbouring farm well waters varied from excellent to very saline, but in most cases, as above, the wells were sunk purely for domestic supplies, and not with a view to large water output. Consequently most wells were shallow—less than 50 feet—and the greatest pumping strain exerted was that of a windmill. No conclusive data can be obtained from the analysis of such samples. A shallow well may give excellent quality water, but a poor supply. The deepening of such a well to increase the output has resulted on occasion in tapping a deeper supply of lower quality. Experience of the necessity for carrying out a pumping test before installing a pumping plant was gained on the Experiment Station in 1934. The well on the Experiment Station has long been known for the excellence of the water quality—3 grains of salt per gallon—and its ability to stand up to continued pumping during droughts. For many years a windmill was the sole test of the well. Some years ago an engine and pump-jack were installed, pumping approximately 900 gallons per hour, and in 1934 this was replaced by a small centrifugal pump delivering 2,000 gallons per hour. Neither of these small pumps

made any appreciable impression on the water level in the well. As the well is only some 42 feet deep the performance was considered a good one. In 1934 we investigated the possibilities of irrigation, and a 3-inch pump was installed temporarily on the well. It succeeded in emptying the well containing its usual 20 feet of water in approximately half an-hour. It could be calculated from the speed of drop of the water, and the rapidity of filling after stopping the pump that the limit of the well would be some four to five thousand gallons per hour.

The above and other cases which have been investigated exemplify the impossibility of calculating the water capacity of a well without actual pumping data. In the above case a bore was put down at the bottom of the well to a total depth of 170 feet without encountering a water-bearing stratum. On another site on the station a bore was sunk to 140 feet, and the only water found was a surface supply between 15 and 45 feet. With four of these bores we were able to obtain a supply approximating to 9,000 gallons per hour. This one instance is sufficient to show that underground water in large amounts cannot be obtained everywhere on the Woongarra. A popular statement is that water can be obtained anywhere if one goes deeply enough for it. Possibly true, but the problem and cost of lifting it must be considered.

It was mentioned above that 182 of the samples of water obtained were suitable for irrigation *on the Woongarra lands.* By this is meant that although suitable here the same waters may not be harmless on sandier soil types. Due to recent developments in soil science and greater knowledge now current on soils and irrigation, waters considered unsuitable for irrigation twenty years ago are now frequently recommended. Not only the water but the soil type must be considered in interpreting water analyses.

During 1933 the well water at Qunaba was investigated insofar as its effect on the Qunaba volcanic soils was concerned. It was desired to find out whether ill effects were likely to accrue from using a water containing 121 grains of total solids, with 89 grains of salt per gallon, on the Qunaba soils. It was already manifest that the water would produce an excellent crop, but the effects of the continued use of it over a number of years were problematical. A detailed analysis of the water was as follows:—

	Grains per gallon.
Chlorides (calculated as common salt)	88·8
Total hardness (calculated as lime carbonate) ..	49·7
Total solids	121·6
Detailed analysis:—	
Chloride	53
Bicarbonate	18
Sulphate	12
Silica	3
Calcium (lime)	6
Magnesium	9
Sodium	20
Potassium	0·35
Total	121·35

It will be observed that the concentration of magnesium salts exceeds that of the lime salts. There was the remote possibility that a concentration of magnesium in the soil may prove detrimental to plant growth. The following test was applied:—A two-foot column of the soil was taken and subjected in the laboratory to leaching with Qunaba water—the equivalent of 20 acre-inches of water being used. This would be comparable with 4 five-inch irrigations. A similar column of soil obtained at the same time was not treated with the water. Both of these samples were taken after irrigation had been carried out with the Qunaba water for five months. Later, after the April, 1933, rains, which aggregated some eight inches, a further sample was taken from the same site to observe the effect of rain in washing out any accumulated salts. The fourth soil sample was taken from a non-cultivated adjacent area which received no irrigation water.

Soil.	pH (Measure of Acidity).		Available Bases as M.E. per 100 Gms.				Available Phosphate p.p.m.	Lime Carbonate %	Chlorine %
	In Water.	In KCl Soln.	Ca (Lime).	Mg (Magnesia).	K (Potash).	Na (Soda).			
No. 1 soil irrigated for 5 months and sampled following a 5″ application	8·27	7·74	32·9	13·1	·43	1·05	481	·32	·03
No. 2 identical with No. 1 but leached in laboratory with further 20″ of water	8·30	7·76	33·3	12·5	·35	1·20	540	·24	·03
No. 3. As No. 1 but sampled after April rains	8·19	7·56	20·8	10·5	·35	1·20	206	·21	·02
No. 4. Non irrigated soil	8·20	7·36	13·8	5·9	·16	·59	169	·03	·006

There is no evidence here of serious accumulation of salt. There is a slight increase in sodium, but so slight as to be almost insignificant. On the figures obtained there appears to be no reason why this water should not be used for crop production on these soils.

It must not be assumed, however, that similar remarks apply to other soil types. On the general run of the Bundaberg forest lands, the subterranean water is of good quality—less than 10 grains of salt per gallon—but it sometimes occurs, on farms near tidal rivers, that the underground water is more saline. In any case outside the red volcanic soils, where only average quality water is procurable, advice should be obtained before continued use for irrigation is practised.

The statement that water unsuitable for washing (that is, which will not lather freely with soap) is unfitted for irrigation is quite incorrect. Many waters contain lime in solution and these certainly could not be used for washing; yet the lime would have a beneficial rather than a deleterious effect on most soils.

A New Type of Irrigation Sprinkler.

By H. W. KERR.

RECENTLY an interesting type of irrigation sprinkler was imported from England for experimental purposes. It was supplied in response to our demand for a simple and effective spray which would give a wide coverage, and therefore necessitate a small number of units per acre. The essential features of the sprinkler are shown in the accompanying illustration (Fig. 33).

FIG. 33.—Illustrating the essentials of the sprinkler head. It is mounted for convenience on a tripod with 5-foot legs.

The water is delivered to the sprinkler through a standard hose connection, and it is ejected through a nozzle set at an angle of approximately 45 degrees. A selection of nozzles is supplied with the unit, enabling one to employ that most suited to the volume and pressure of water available. The device by which the water spread is secured is simple and ingenious. The jet from the nozzle impinges on a wheel, the periphery of which is slotted. The force of the water causes the wheel to revolve, and the small fins break up the stream into drops of greater or less dimensions. A few of the fins are turned in such a manner as to offer a direct obstruction to the water flow, and the intermittent impulses caused by these gives the entire head a slow revolving action. Nozzle and wheel are thus carried through a complete circle in a period of from one to two minutes.

The manufacturers claim that the sprinkler will operate at pressures ranging from 10 to 100 lb., while a coverage of ½ acre is possible under the best conditions. The application of water ranges from 5 to 28 gallons per minute, depending on the pressure

available and the size of jet employed. The coverage is likewise adjustable by these means. The model under trial was supplied for a $\frac{3}{4}$ inch hose connection, and the nozzles were from $\frac{5}{32}$ inch to $\frac{13}{32}$ inch diameter. This unit will irrigate $\frac{1}{4}$ acre. The larger model, with $1\frac{1}{2}$ inch hose connection, is intended for use with water pressures of 55 lb. or more. The nozzle sizes are from $\frac{7}{16}$ inch to $\frac{21}{32}$ inch diameter. This unit will deliver from 30 to 70 gallons of water per minute, and gives a coverage of from $\frac{1}{4}$ to $\frac{1}{2}$ acre.

The price of the sprinkler is listed as £3, in England, and at this cost it should be of interest to many of our canegrowers. Though it suffers all the drawbacks previously outlined for spray irrigation, there are certain uses to which it might be put on the cane farm. As a means of irrigating the kitchen vegetable patch or a small block of horse feed, on a relatively low pressure, it should prove ideal, while to the grower who wishes to exploit intermittent irrigation on young cane, to help it through a dry spell when necessary, the sprinkler is strongly recommended. In this connection it should have a very definite value where the canegrower could provide water in a channel adjacent to the cane block; from this it could be taken up by a portable engine and small pump, and driven through two or three of these units suitably placed in the field of young cane. The advantage it offers, particularly where the water supply is limited, is its ability to enable a 1-inch watering to be applied uniformly and rapidly. On the average values given above for the large, high-pressure unit, 1 acre-inch could be applied to $\frac{1}{3}$ acre, by one unit, in the course of two and a-half hours.

David Whyte, Government Printer, Brisbane.